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# ANTENNAL SENSILLA AND SETAL PATTERNS OF THE GOLDENROD GALL FLY, *EUROSTA SOLIDAGINIS* (FITCH) (DIPTERA: TEPHRITIDAE)

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*Abstract.*—The sensilla and setal patterns of the antennae of the goldenrod gall fly were investigated by scanning electron microscopy. Sexual dimorphism is clearly evident on the first flagellomere and arista of the flies. On the flagellar surface, the female exhibits only one type of trichoid sensillum while the male exhibits three types; a trichoid type like that of the female and two sizes of basiconic sensilla. The point of attachment of the arista of the female bears an additional cup-like articulation that is not present in the male and the female also has an obvious button-like protuberance on the lateral border of each arista near the distal end, which is absent in males.

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*Eurosta solidaginis* (Fitch) is responsible for the formation of round galls commonly observed on the stems of various species of the goldenrod *Solidago*. Uhler (1951) has furnished the most complete work to date on the biology and ecology of this fly and indicated that the species is widely distributed throughout the United States and Canada. Other studies by Milne (1940) and Miller (1959) have also contributed information regarding the natural history of this insect.

The method by which *E. solidaginis* selects the appropriate species of *Solidago* for oviposition is unknown. It is conceivable that the attraction may be chemosensory and that the antennal sensilla could play an important role in host selection. Several recent studies on the antennae of Diptera have demonstrated the presence of such chemosensory sensilla (Bay and Pitts, 1976; White and Bay, 1980; Honda, Ishikawa and Matsumato, 1983; Vasey and Ritter, 1983; and Venkatesh and Singh, 1984). Up to now, no such inquiry has been undertaken on the goldenrod gall fly.

The purpose of this investigation was to examine the sensilla and setal patterns of the antennae of *E. solidaginis* and to provide the basis for additional demonstrations of the importance of antennal sensilla in mating and host selection.

## MATERIALS AND METHODS

Specimens of *Eurosta solidaginis* initially used in this work were obtained from the insect collections of the State University of New York College of Arts and Sciences at Geneseo. All of these had been reared from galls collected on *Solidago canadensis* L. Additional specimens were reared from galls supplied by Dr. Warren G. Abrahamson of Bucknell University. These had been collected from *Solidago altissima* L. in February 1985 near Lewisburg, Pennsylvania, and had been held at −23°C until the time they were shipped. When received, the galls were placed in rearing cages for 10–14 days at which time flies emerged. Specimens were killed with ethyl acetate and then decapitated. Heads of 10 males and 10 females were examined. Five of each sex were mounted laterally and the remaining five were mounted full face on aluminum stubs with silver paint. The specimens were then gold coated in

a Polaron diode sputterer and examined on an ISI Alpha-9 Scanning Electron Microscope.

## OBSERVATIONS AND DISCUSSION

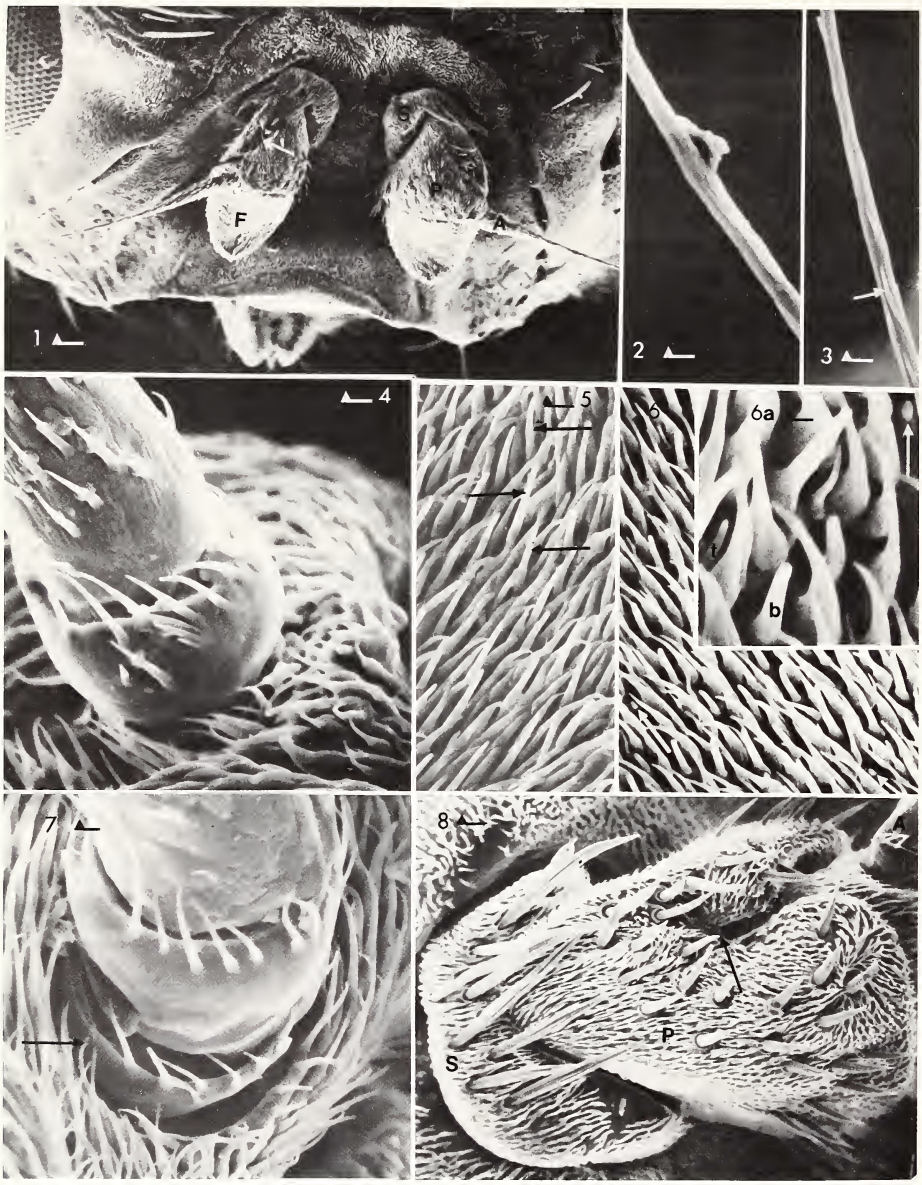
The antenna of the goldenrod gall fly was superficially described by Uhler (1951). It consists of a scape, pedicel and flagellum, the basal subsegment or flagellomere of which is greatly enlarged and bears a non-plumose arista arising dorsolaterally from its base (Fig. 1).

Although the first flagellomere is similar in size and shape in both sexes, there is a marked sexual dimorphism evident as to type and arrangement of the sensilla. In the female (Fig. 5) each flagellum is densely covered on all sides by microtrichia. Interspersed with these microtrichia are a large number of linearly placed, elongate, trichoid sensilla that are similar to the A-type of Dethier (1976). These are readily identified from the microtrichia by their gently rounded distal ends and lighter color. These sensilla also resemble the thin walled chemoreceptors described by Slifer (1970). Such sensilla have been described on the antennae of other Diptera, for example, that of the face fly by Bay and Pitts (1976) and the horn fly by White and Bay (1980).

The flagellar segment of the male, like that of the female, is densely covered with microtrichia. Interspersed with these are three different types of sensilla (Fig. 6, 6a). The elongate trichoid sensilla (t) described for the female are present, but are not as numerous and are not as regularly arranged. There are in addition two sizes of basiconic sensilla. The shorter ones (Fig. 6a, arrow) may occur singly or occasionally in pairs while the longer (b) of these are more numerous and always arise singly. In each case they ascend from well marked areas that are surrounded by microtrichia. These basiconic sensilla appear to be similar to the thick walled chemoreceptors described by Slifer (1970).

The point of attachment of the arista to the flagellum is different in each sex. In the female there is an additional cup-like basal articulation (Fig. 7) which is not present in the male (Fig. 4). In both sexes, the edges of the articulation points are encircled by a single row of unbranched microtrichia. The aristae of both sexes are non-plumose; they are, however, sparsely covered with small branched microtrichia that decrease in number and frequency distally. As one moves closer to the terminus, the aristal microtrichia become flattened and scale-like in appearance (Fig. 3). The male arista bears no other structure. The female, on the other hand, has an obvious button-like protuberance which is found on the inner, lateral border of each arista, approximately ⅓ distant from the tip, near the point where the arista begins to narrow sharply (Fig. 2). These are obviously sensilla and, by their appearance, suggest a chemosensory function. We cannot find reference to any such structure previously reported in the literature.

SEM investigation of the scape and pedicel shows setal patterns but reveals nothing in the way of sensilla. The pedicel is marked by a conspicuous dorsal cleft (Figs. 1, 8) found in other Tephritidae (McAlpine, 1981). The surfaces of both subsegments are covered with the same type of microtrichia as described above for the first flagellomere. However, interspaced with these (Fig. 8) are two sizes of fluted setae which arise from sockets. The dorsal leading edge of the scape bears two alternating rows of anteriorly directed long setae (Fig. 8). Those of the pedicel are shorter. A staggered row of these setae line the innermost margin of each cleft while the re-




Figs. 1–8. Front view of *Eurosta solidaginis* showing paired antennae: arrow indicates dorsal, longitudinal cleft, first flagellomere (F), arista (A), pedicel (P), and scape (S). 50×, Bar = 56.5 μm. 2. Arista of female showing inner, lateral, button-like protuberance. 1,000×, Bar = 2.6 μm. 3. Arista of male. Arrow indicates flat, scale-like microtrichia. 400×, Bar = 10 μm. 4. Junction of the arista to the first flagellomere of the male. 700×, Bar = 3.7 μm. 5. Dorsal surface of first flagellomere of female. Arrows indicate linear arrangement of trichoid sensilla. 700×, Bar = 3.7 μm. 6. Dorsal surface of first flagellomere of male. Long basiconic sensillum (b), short basiconic sensilla (arrow), trichoid sensillum (t). 700×, Bar = 3.7 μm. 6a. 2,000×, Bar =

maining setae are irregularly arranged on the dorsal surface and continue ventrally. The setae of the ventral aspect are longer than those found dorsally.

According to Uhler (1951), the male emerges from the gall one to two days before the female and orients himself on the terminal bud of the host goldenrod plant and awaits the female. It is conceivable that the flagellar sensilla of the male plays a role in locating the suitable portion of the host plant using chemosensory cues.

One of the major differences between the sexes, however, is the button-like protuberance present only on the arista of the female. Structurally it resembles a sensory sensillum which would be capable of detecting stimuli emanating from the male. Such antennal sensilla would explain attraction to a suitable host plant which then could result in mating and subsequent oviposition.

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1.3 μm. 7. Junction of the arista to the first flagellomere in the female showing additional cup-like articulation. 700×, Bar = 4.2 μm. 8. Side view of scape (s) and pedicel (p); arrow indicates dorsal longitudinal cleft. 200×, Bar = 12.8 μm.